



# Seawater System Design for Broodstock and Laboratory Cultivation of Blue King Crab *Paralithodes platypus* Larvae



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## Abstract

Few studies have been conducted on blue king crab *Paralithodes platypus* larvae, and no information is available on glaucothoe settlement behavior and habitat selection. A recirculating seawater system for the maintenance of blue king crab broodstock and a kreisel tank culture system for larval rearing were designed to facilitate laboratory studies of early-life history. The chilled-water recirculating and culture systems are crucial to successful blue king crab culture, since the 0° - 8° C water temperatures in which this species lives cannot be maintained by the laboratory's flow-through seawater system during the summer months. The 9300-liter recirculating system is maintained between 3° and 5° C and currently holds 11 individuals. The recirculating system includes two round tanks (6860 liters), a bead filter, a biofilter, an O<sub>2</sub> generator, an O<sub>2</sub> saturator, an ultraviolet light sterilizer, and a Venturi-style protein skimmer. The larval culture system consists of 12 kreisel tanks of 22 liters each, with a heated or chilled head tank to provide temperature control. The kreisel tank design allows larvae and food to stay in suspension through the upwelling motion of water in each tank. Various diets, temperatures and larval densities will be tested on the newly hatched larvae to determine optimal conditions for culture. Diets will include *Artemia* nauplii, enriched *Artemia* nauplii, and *Artemia* nauplii in combination with live algae.



Dorsal view of a female blue king crab, carapace length 127 mm.

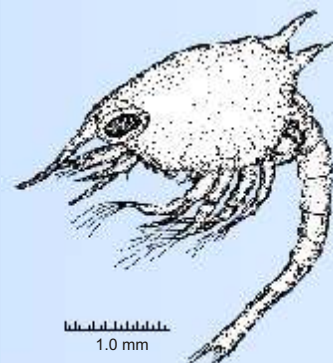


Frontal view of a blue king crab showing characteristic coloration.

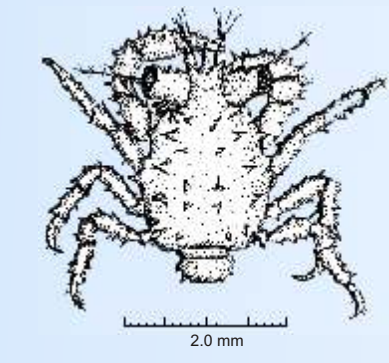


Ventral view of a blue king crab showing a clutch of developing eggs. Crabs with eggs will be isolated at time of larval hatch and larvae will be collected and transferred to the kreisel tanks.

Blue King Crab Zoea III



Blue King Crab Glaucothoe



From Hoffman, E. 1968. Description of laboratory-reared larvae of *Paralithodes platypus* (Decapoda, Anomura, Lithodidae). J. Fish. Bd. Canada, 25(3): 439-455.

## Larval Culture System

The larval culture system (fig. 1) consists of 12 kreisel tanks of 22 liters each maintained on a low-flow flow-through system with a heated or chilled head tank to provide temperature control. The water will pass through two cartridge filters of 10 and 1 microns and then through a UV sterilizer. The cone-shaped bottom design of the kreisel tank (fig. 2) combined with the influx of water at the bottom of the tank allows larvae and food to stay in suspension through the creation of upwelling motion in the water. Maintaining food and larvae in suspension improves water quality by reducing the build up of food on the bottom of the tanks and preventing larvae from settling on the bottom. Larval contact with the tank and other zoeae can result in damaged spines and cannibalistic encounters. Poor water circulation and quality can result in bacterial, algal and protozoal growth on carapaces and gills leading to decreased ability to swim, feed, respire and molt. The water circulation patterns of the kreisel tanks, combined with water filtration and UV sterilization, should result in a high zoeal survival rate.

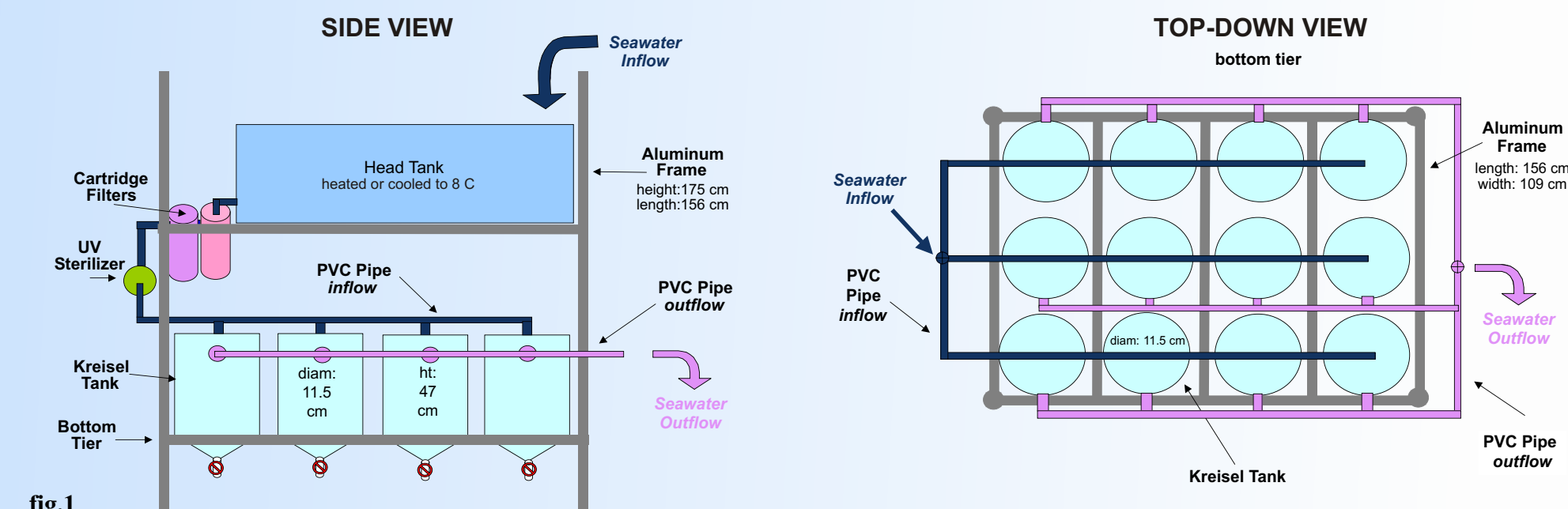
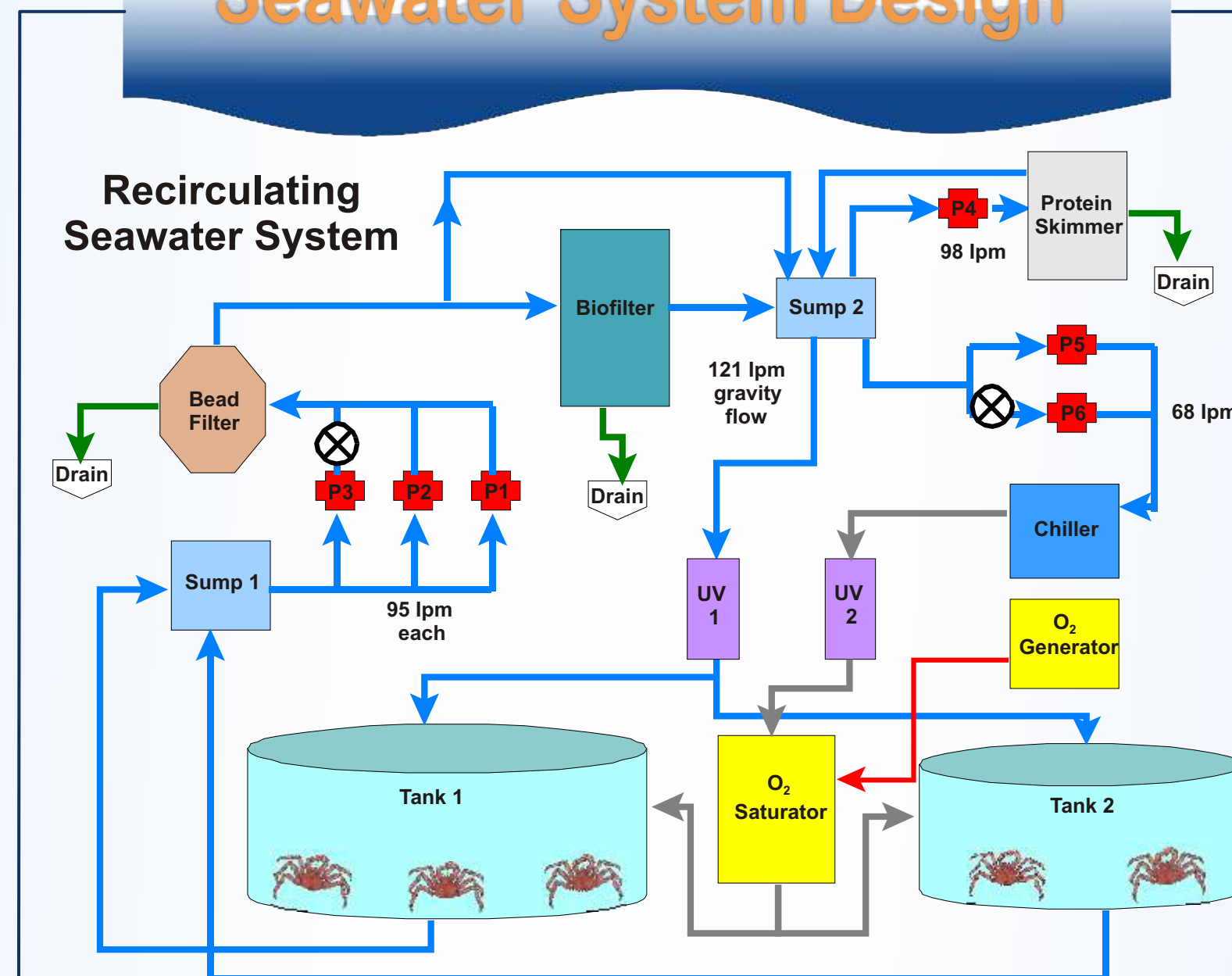


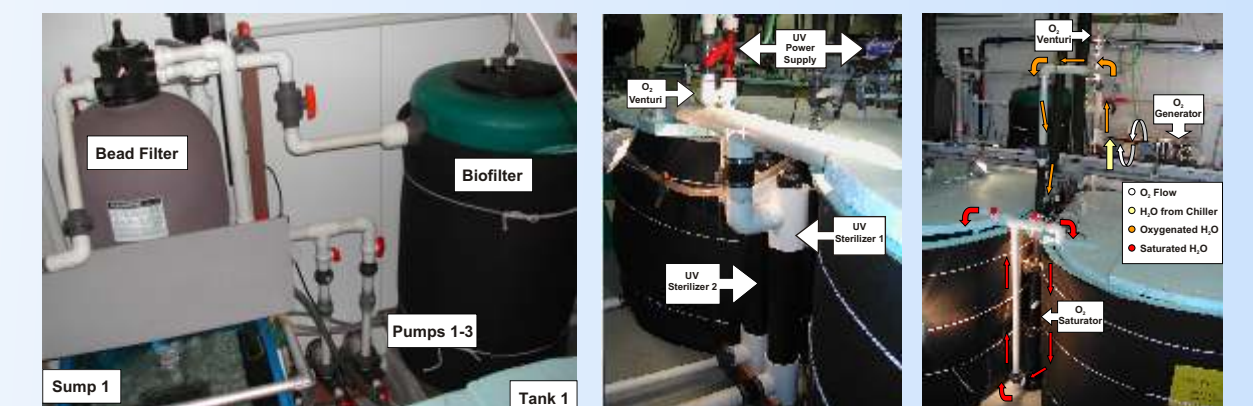
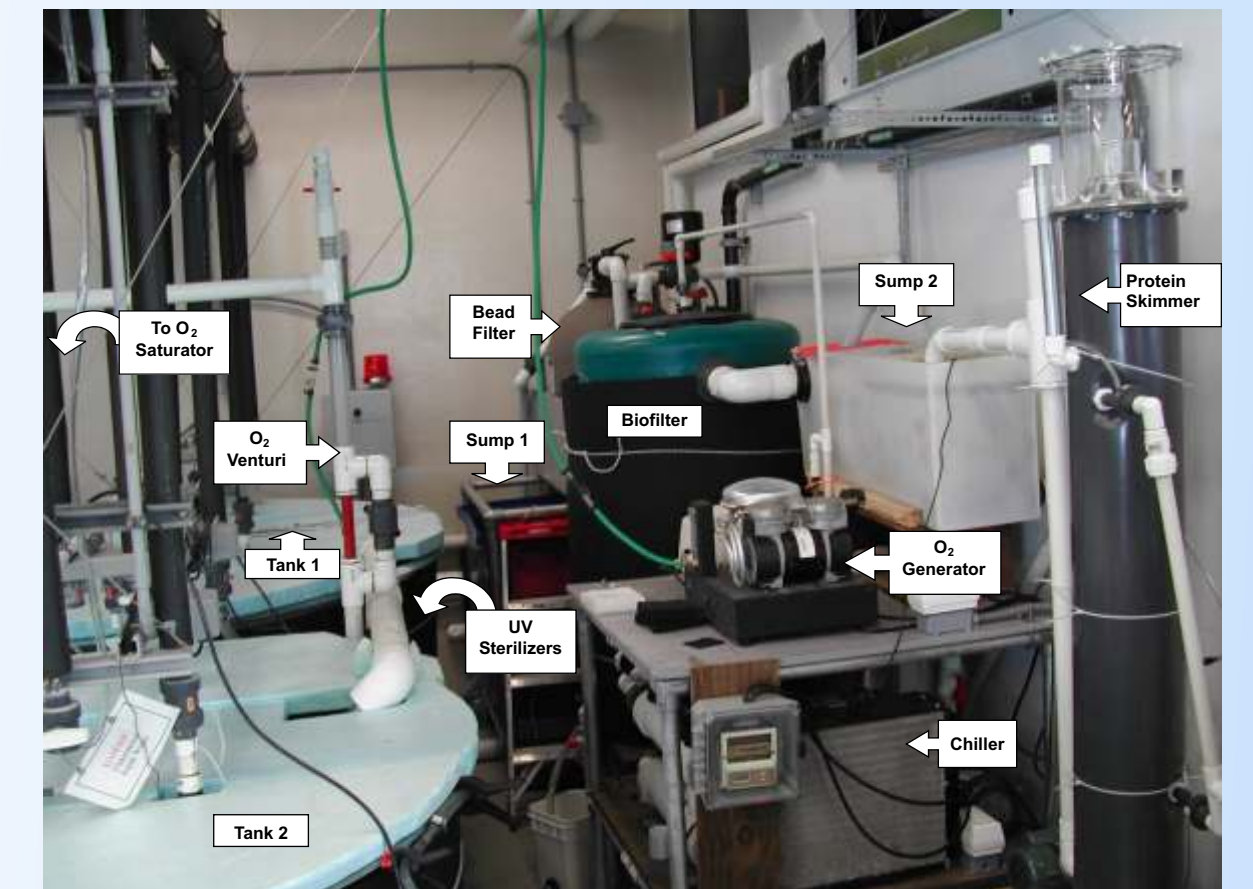
fig.1

## Seawater System Design



- Water collected from crab tanks 1 and 2 (6860 l) flows by gravity into sump 1 (568 l).
- Pumps 1 and 2 send the water from sump 1 to the bead filter (189 l).
- Half of the water from the bead filter goes to the biofilter (568 l) and half goes to sump 2 (95 l).
- The water leaving the biofilter also goes into sump 2.
- From sump 2, pump 4 sends water into the protein skimmer which is then returned back to sump 2.
- From sump 2, pump 5 sends water through the chiller, through UV sterilizer 2, the O<sub>2</sub> Venturi and O<sub>2</sub> saturator, and back to the crab tanks.
- Any remaining water from sump 2 overflows to UV sterilizer 1, and flows back to crab tanks 1 and 2.

The flow-through seawater system used for maintaining crabs at the Kodiak laboratory experiences temperatures as high as 13° C during August, conditions fatal to blue king crab. Chilling this system is impractical due to the energy requirements, so a separate system was designed to chill the seawater by recirculation. However, the retention of water in the recirculating system results in the buildup of food wastes, feces, NH<sub>3</sub>, and CO<sub>2</sub> and requires filters to remove particles and to denitrify and de-gas the water.



- **Sump 1** - provides primary filtration of large particles as well as filtration through activated carbon pads
- **Bead filter** - removes small particulates (< 20 u) that attach to bead media
- **Biofilter** - contains a culture of nitrifying bacteria that adhere to high surface area "mini-bioballs" and convert NH<sub>3</sub> → NO<sub>2</sub> → NO<sub>3</sub>
- **Chiller** (in-line) - 1.75 hp; maintains temperature of the system at 4-5° C
- **Protein skimmer** (Venturi style) - removes DOC (dissolved organic compounds) by foam fractionating
- **Oxygen generator** - air compressor and filters separate air into its components and concentrate O<sub>2</sub> (90-95% purity) and deliver it to the system at 0-3.8 std l min<sup>-1</sup>
- **Oxygen Venturi** - mixes chilled seawater with O<sub>2</sub> gas
- **Oxygen saturator** - dissolves O<sub>2</sub> bubbles into solution with 100% efficiency and delivers supersaturated O<sub>2</sub> to both tanks
- **UV sterilizers** (in-line) - UV lamps irradiate the water at 237 nm and kill heterotrophic bacteria
- **Flow switches** - turn off the system if the pumps fail
- **Redundant pumps** - pumps are rotated with a backup on standby

## Project Summary

The recirculating seawater system and kreisel tank culture system were designed to support studies of blue king crab (BKC) early life history. The population of BKC in the Pribilof Islands, Alaska, has declined precipitously in the last two years, and is now defined as overfished. In their first few years of life BKC are restricted to limited habitats around the Pribilof Islands that are critical to their survival. We seek to understand the relationship between Essential Fish Habitat (EFH) for Pribilof Islands BKC and survival in the first year of life. We plan a three-year laboratory study of habitat utilization by juvenile blue king crabs, in which we will study settlement behavior and habitat selection, survival of larval and juvenile blue king crabs, and competitive interactions with juvenile red king crabs. During the first year of the study we will verify our ability to raise BKC larvae in the laboratory and determine optimum cultivation conditions by testing various diets, temperatures and larval densities. Diets will include *Artemia* nauplii alone, enriched *Artemia* nauplii, and *Artemia* nauplii in combination with live algae. The second year of the study will involve habitat selection and preference studies with larval and juvenile BKC, and the third year will involve competitive interactions and survival in optimal habitats. The North Pacific Research Board is providing partial funding for this project.